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INHALATION/EXHALATION VALVE UNIT HAVING
LIGHT MOVABLE COMPONENTS
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Fig. 1.

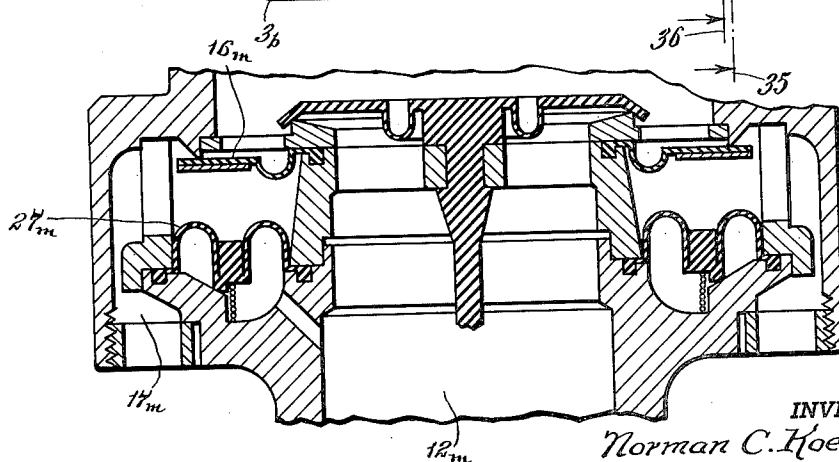
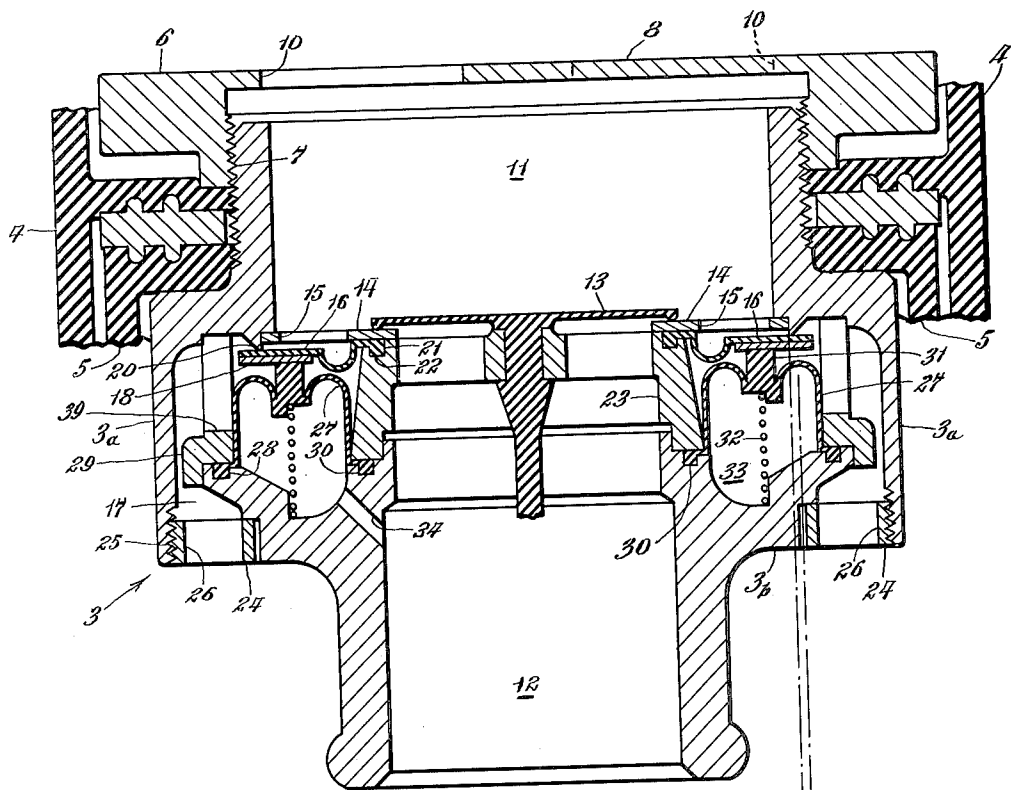


Fig. 2.

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INHALATION/EXHALATION VALVE UNIT HAVING LIGHT MOVABLE COMPONENTS

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4 Claims. (Cl. 137—64)

This invention relates to a valve unit associated with a breathing apparatus of the demand type and supplied with oxygen under pressure, said unit being adapted to control the flow of oxygen both into a breathing mask or a breathing mouthpiece, and also to control the exhalation therefrom of the foul air.

The primary object of the invention is to provide a valve unit of the above described character which will prevent ambient air from being accidentally drawn inwardly through the exhalation valve as a consequence of periodic vibrations in the gases involved or of sudden changes in the inertia or momentum of both the gases and the mechanical parts of the unit, particularly at those times when the inlet pressure of the oxygen is very low.

Other objects of the invention and practical solutions thereof are described in detail in the following description, and are illustrated in the accompanying drawing wherein:

FIG. 1 is a vertical, medial, longitudinal section through one form of my improved inhalation-exhalation valve unit.

FIG. 2 is a fragmentary, vertical, medial, longitudinal section through a modified form of my invention, showing the same in the positions which are assumed by some of its component parts when the inlet pressure drops very low.

FIG. 1

For convenience, it will be assumed in this description that the breathing fluid which is supplied to the unit is pure oxygen, although diluted oxygen or pure compressed air may be supplied instead. Also, the invention will be described precisely as it is here illustrated, but it is to be definitely understood that the breadth of the invention is to be measured solely by its intrinsic, patentable novelty and by the scope of the appended claims.

The casing 3 (consisting primarily of the upper and lower casing sections 3a and 3b) is clamped in the conventional manner to the walls 4 and 5 of a breathing mask (not shown) by a flanged clamping ring 6 which has a threaded engagement with the threads 7 of said upper casing section 3a and is located within the interior of said mask. The central web 8 of said clamping ring 6 is provided with three pie-shaped apertures 10 to permit the free flow of fresh oxygen from the breathing compartment 11 of the casing 3 into the interior of the mask, or, vice versa, the reverse flow of foul or exhaled air from said mask into said breathing compartment 11.

Fresh oxygen is supplied to the casing 3 through an inlet 12 and is allowed to flow, during the inhalation cycle, from said inlet 12 to said breathing compartment 11 through a conventional, rubber, inhalation valve 13. The valve seat of said inhalation valve 13 consists of an annular, sheet-metal ring 14 provided, adjacent its periphery, with a plurality of kidney-shaped apertures 15 which permit exhaled air to flow from the breathing compartment 11 down through the rubber exhalation valve 16 and into the outlet 17. The periphery of this exhalation valve 16 is reinforced by a sheet-metal backing plate ring 18 which is cemented to the lower face of the said exhalation valve. This exhalation valve is so molded that, in the position shown, it makes firm but resilient contact with its annular, knife-edge, valve seat 20. To

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provide hermetic sealing, the inner, annular edge of this exhalation valve 16 is provided with an annular bead 21 which is pressed into a suitable annular groove 22 which is formed in the top flat face of a compression tube 23. The latter is pushed up against the lower flat face of the sheet-metal ring 14 by a clamping ring 24 which is threaded at 25 into the lower end of the upper section 3a of the casing 3. Adjacent its periphery, this clamping ring 24 is provided with an annular row of apertures 26 which permit foul air to pass through said ring 24 into the ambient atmosphere.

Arranged below said exhalation valve 16 is a dually-corrugated, ring-shaped, rubber, balancing diaphragm 27 whose outer and inner annular edges are provided with beads 28 and 30 to ensure hermetic sealing with the lower section 3b of the casing 3. The bead 28 is held in place by an annular sleeve or coaxial castellated ring 29 provided with an annular row of slots 39. Intermediate its corrugations, this balancing diaphragm 27 is provided integrally with an annular pressure ring 31 which normally is resiliently urged upwardly against the metal ring 13 of the exhalation valve 16 by a helical compression spring 32. The space below said balancing diaphragm 27 may be termed a balancing chamber 33 that communicates with the inlet 12 through a balancing duct 34.

Normally the balancing diaphragm 27 performs no special function, but merely rises and falls with the exhalation valve 16. In actual practice, however, it has been found occasionally (especially when the pressure in the inlet 12 is low) that periodic vibrations or buzzings are set up in the gases in the unit and also that such vibrations occasionally result from sudden changes of inertia or momentum of both said gases and of the mechanical components of the unit. These occurrences sometimes act in such a manner as to allow ambient air to be drawn inwardly through the exhalation valve 16. In the present invention this difficulty has been prevented by interposing the balancing diaphragm 27 between the inlet 12 and the exhalation valve 16, and interposing said diaphragm in such a manner that a sudden drop of pressure in said inlet 12 merely draws down said diaphragm 27 instead of opening said exhalation valve 16. In addition to this, any sudden or vibrational force emanating from an increase in pressure in the breathing compartment 11, or downwardly directed force caused by a change in inertia or momentum in the exhalation valve 16 itself, is resisted by both the inherent resilience of the exhalation valve 16 itself and, in addition, by the resilient resistance of the helical spring 32.

It should also be noted that all of the movable parts of the present invention are relatively light in weight so that the forces resulting from inertia or momentum are comparatively small. This is because the only moving parts of the unit are portions of the inhalation and exhalation valves 13 and 16 and of the balancing diaphragm 27.

Based upon purely empirical data, it has been found desirable to provide an increase in the pneumatic force tending to close the exhalation valve 16 whenever the pressure in the inlet 12 is very high. This result has been effected in the present invention by having the effective diameter 35 of the balancing diaphragm 27 appreciably larger than the diameter 36 of the valve seat 20 of the exhalation valve 16.

FIG. 2

This figure illustrates both a slight modification of the invention and also the position of the balancing diaphragm 27m when a drop in pressure in the inlet 12m would tend to open the exhalation valve 16m and allow inhalation from the outlet 17m if it were not for the interposition of said balancing diaphragm 27m.

I claim:

1. An inhalation/exhalation valve unit having light movable components and adapted to control the inhalation of fresh breathing fluid into a breathing mask or a breathing mouthpiece and to control the exhalation therefrom of foul breathing fluid, comprising, a casing having an inlet, an outlet, and a breathing compartment adapted to communicate with a breathing mask or breathing mouthpiece, an inhalation valve interposed between said inlet and said breathing compartment, an exhalation valve including seating means interposed between said breathing compartment and said outlet, said exhalation valve being constructed and arranged to normally be in cooperative engagement with said seating means, a balancing diaphragm having an exterior side in communication with said outlet and its interior side in communication with said inlet, and force-transferring means between said balancing diaphragm and said exhalation valve whereby expansion of said balancing diaphragm urges said exhalation valve toward its closed position, said force-transferring means being uni-directional, whereby contraction of said balancing diaphragm is independent of said exhalation valve.

2. An inhalation/exhalation valve unit having light movable components and adapted to control the inhalation of fresh breathing fluid into a breathing mask or a breathing mouthpiece and to control the exhalation therefrom of foul breathing fluid, comprising, a casing having an inlet, an outlet, a breathing compartment adapted to communicate with a breathing mask or breathing mouthpiece, an inhalation valve interposed between said inlet and said breathing compartment, an exhalation valve including seating means interposed between said breathing compartment and said outlet, said exhalation valve being constructed and arranged to normally be in cooperative engagement with said seating means, means including a balancing diaphragm defining a balancing chamber in communication with said inlet, force-transferring means between said balancing diaphragm and said exhalation valve whereby expansion of said balancing diaphragm urges said exhalation valve toward its closed position, said force-transferring means being uni-directional, whereby contraction of said balancing diaphragm is independent of said exhalation valve, and resilient means within said balancing chamber urging said balancing diaphragm into an expanded position.

3. An inhalation/exhalation valve unit having light movable components and adapted to control the inhalation of fresh breathing fluid into a breathing mask or a breathing mouthpiece and to control the exhalation therefrom of foul breathing fluid, comprising, a casing having

an inlet, an outlet, and a breathing compartment adapted to communicate with a breathing mask or breathing mouthpiece, an inhalation valve interposed between said inlet and said breathing compartment, an annular exhalation valve including seating means interposed between said breathing compartment and said outlet, said exhalation valve being constructed and arranged to normally be in cooperative engagement with said seating means, a backing plate for said exhalation valve, a balancing diaphragm having its interior side in communication with said inlet, and a pressure ring carried by said balancing diaphragm for contact with said exhalation valve, backing plate, whereby expansion of said balancing diaphragm urges said exhalation valve toward its closed position, said balancing diaphragm contracting independently of said exhalation valve.

4. An inhalation/exhalation valve unit having light movable components and adapted to control the inhalation of fresh breathing fluid into a breathing mask or a breathing mouthpiece and to control the exhalation therefrom of foul breathing fluid, comprising, a casing having an inlet, an outlet, a breathing compartment adapted to communicate with a breathing mask or breathing mouthpiece, an inhalation valve, means supporting said inhalation valve between said inlet and said breathing compartment, an exhalation valve including seating means interposed between said breathing compartment and said outlet, said exhalation valve being constructed and arranged to normally be in cooperative engagement with said seating means, said exhalation valve being movable independently of said inhalation valve and support means, means including a balancing diaphragm defining a balancing chamber in communication with said inlet, force-transferring means between said balancing diaphragm and said exhalation valve whereby expansion of said balancing diaphragm urges said exhalation valve toward its closed position, and resilient means urging said diaphragm into an expanded position, said force-transferring means being uni-directional, whereby contraction of said balancing diaphragm is independent of said exhalation valve.

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